National Institute of Environmental Health Sciences

Implications of climate change on the distribution of the tick vector Ixodes scapularis and risk for Lyme disease in the Texas-Mexico transboundary region

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Abstract:

Background: Disease risk maps are important tools that help ascertain the likelihood of exposure to specific infectious agents. Understanding how climate change may affect the suitability of habitats for ticks will improve the accuracy of risk maps of tick-borne pathogen transmission in humans and domestic animal populations. Lyme disease (LD) is the most prevalent arthropod borne disease in the US and Europe. The bacterium Borrelia burgdorferi causes LD and it is transmitted to humans and other mammalian hosts through the bite of infected Ixodes ticks. LD risk maps in the transboundary region between the U.S. and Mexico are lacking. Moreover, none of the published studies that evaluated the effect of climate change in the spatial and temporal distribution of I. scapularis have focused on this region. Methods: The area of study included Texas and a portion of northeast Mexico. This area is referred herein as the Texas-Mexico transboundary region. Tick samples were obtained from various vertebrate hosts in the region under study. Ticks identified as I. scapularis were processed to obtain DNA and to determine if they were infected with B. burgdorferi using PCR. A maximum entropy approach (MAXENT) was used to forecast the present and future (2050) distribution of B. burgdorferi-infected I. scapularis in the Texas-Mexico transboundary region by correlating geographic data with climatic variables. Results: Of the 1235 tick samples collected, 109 were identified as I. scapularis. Infection with B. burgdorferi was detected in 45% of the I. scapularis ticks collected. The model presented here indicates a wide distribution for I. scapularis, with higher probability of occurrence along the Gulf of Mexico coast. Results of the modeling approach applied predict that habitat suitable for the distribution of I. scapularis in the Texas-Mexico transboundary region will remain relatively stable until 2050. Conclusions: The Texas-Mexico transboundary region appears to be part of a continuum in the pathogenic landscape of LD. Forecasting based on climate trends provides a tool to adapt strategies in the near future to mitigate the impact of LD related to its distribution and risk for transmission to human populations in the Mexico-US transboundary region.

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Resource Description

Early Warning System: ☒

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure : ☑

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Temperature

Temperature: Fluctuations

Geographic Feature: ☑

resource focuses on specific type of geography

None or Unspecified

Geographic Location: ☑

resource focuses on specific location

Non-United States, United States

Non-United States: Non-U.S. North America

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Tick-borne Disease

Tick-borne Disease: Lyme Disease

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Medium-Term (10-50 years)

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content